REMARKS

The foregoing amendment amends claims 1, 58, 61, 90, 120, 197, 199, and 201, cancels claims 29-57, 100 and 202-203, and adds new claims 223-225. Pending in the application are claims 1, 3-28, 58, 60-97, 99-122, 124-150, 197-227, of which claims 1, 58, 90, 120, 190, 197, 199, 201 and 227 are independent. The following comments address all stated grounds for rejection and place the presently pending claims, as identified above, in condition for allowance.

Claims 1, 58, 120, 197 and 199 are amended to specify that each fluid interface port has a depth equal to a thickness of an associated side wall and a diameter that is significantly larger than the depth so as to minimize a total volume of the fluid interface port. Support for the amendment can be found throughout the application as originally filed, at least, for example on page 17, lines 12-26, page 22, line 23-page 23, line, and as shown in Figures 2A and 2B.

The amendment to claims 1, 58, 120, 197 and 199 and new claims 223-225 further specify that the meniscus comprising the virtual wall is substantially co-planar with the side wall of the microchannel in which the meniscus is formed, as described on page 18, lines 31-32 of the original specification and as shown in Figures 3B, 4A and 9A-9E.

Claim 61 is amended for purposes of clarity.

Claim 90 is amended to recite the patentable subject matter of claim 100 and to further specify that the dead volume is less than one picoliter.

Claim 201 is amended to recite the patentable subject matter of claim 202, namely that the covering layer comprises covering fluid that is immiscible with the fluid disposed in the interior of the microchannel. *No new matter is added.*

Amendment and/or cancellation of the claims is not to be construed as an acquiescence to any of the objections/rejections set forth in the instant Office Action, and was done solely to expedite prosecution of the application. Applicant reserves the right to pursue the claims as originally filed, or similar claims, in this or one or more subsequent patent applications.

35 U.S.C. 102 Rejections

Applicants thank the Examiner for the close review of the claims and for indicating that claims 8, 9, 37, 39, 69, 70, 99, 100, 129, 130, 202 and 203 recite patentable subject matter. In the Office Action, the Examiner rejects claims 1, 7, 16-19, 24, 29-31, 39, 40, 45, 46, 47, 48, 53, 58, 60, 61-63, 77, 78, 80, 90-93, 101, 102, 107, 108, 110, 120, 128, 131, 132, 137, 139, 149, 201 and 222 under 35 U.S.C. 102(e) as being anticipated by the Chow reference (U.S. Patent Number 6,494,230). The Examiner rejects claims 1, 3-6, 10-13, 16, 18, 19, 22-24, 27-35, 39, 40-42, 45, 48, 51-53, 56-58, 60, 61-63, 71-74, 77, 80, 88, 89, 120, 131, 132, 139, 142, 143, 147-149 and 197-200 under 35 U.S.C. 102(e) as being anticipated by the Handique reference (U.S. Patent Number 6,130,098). The Examiner also rejects claims 1, 7, 145, 16, 18, 19, 24-26, 29-31, 36, 39, 40, 44, 45, 48, 53-55, 58, 60, 61-63, 68, 76, 80, 85-87, 90-93, 106, 107, 115-117, 120-122, 128, 131, 132, 136, 139, 144-146, 149, 150, 201 and 222 under 35 U.S.C. 102(e) as being anticipated by the Fuchs reference (U.S. Patent Number 5,757,482).

Claims 90 and 201 have been amended to include patentable subject matter, indicated as allowable by the Examiner. Specifically, claim 90 has been amended to specify that the covering layer comprises a non-evaporating liquid. Claim 201 has been amended to specify that the covering fluid is immiscible with the fluid disposed in the interior of the microchannel. As recognized by the Examiner, the cited references fail to teach or suggest a covering layer in a fluid interface port that is formed of a non-evaporating or immiscible fluid. Therefore, claims 90-97, 99, 101-118 and 201 should be in immediate condition for allowance.

Applicants have amended independent claims 1, 58, 120, 197 and 199 to specify that each fluid interface port has a depth that is substantially *less than* the diameter of the fluid interface port to minimize overall volume. The recited fluid interface ports thus have has a disk shape, as shown in Figures 2A and 2B, and described on page 17, lines 19-20 of the application, to facilitate *direct* access to the channel interior, a feature not taught or suggested in the cited references.

In contrast to the claimed configuration, the passage 310 of Chow, which the Examiner considers to be a fluid interface port, comprises a channel having a depth that is significantly *larger* than the cross-section of the channel, which prevents direct interfacing of the channel

interior with the ambient. In addition, the vent 70 in Handique, which the Examiner considers to be a fluid interface port, also forms a channel having a depth that is significantly *larger* than the cross-section of the channel, in contrast to the claimed invention.

The Fuchs reference also does not disclose the claimed invention. As shown in Figure 4, the cross-sectional diameter of the port 24 in Fuchs is significantly *larger* than the channels 12. In addition, the Fuchs reference discloses that the port 24 is formed in the cover 12, which is at least 400 microns thick, as set forth in column 5, lines 12-14. Therefore, even *if* the diameter of the port 24 were significantly larger than the depth, as recited in claims 1, 58, 120, 197 and 199, the diameter would be required to be several times the recited range of between about 25 μm and about 100 μm, precluding formation of a virtual wall, specifically a virtual wall with minimal dead volume. In clear contract to the claimed invention, the port 24 in Fuchs is *large*, does not form a meniscus, or a meniscus capable of forming a virtual wall, does not minimize dead volume, and does not form a *direct* interface between a channel interior and an external environment.

In addition, claims 1, 58, 120, 197 and 199 further distinguish over the cited references, because the references fail to disclose a fluid interface port forming a virtual wall having a meniscus surface that is co-planar with a side wall in which it is formed. Even if a meniscus were formed in the channel 301 of Chow, the vent 70 of Handique and/or the port 24 of Fuchs, such a meniscus would only be formed in a top portion of the channel and would not align with the side wall in which the channel is formed, as recited in claims 1, 58, 120, 197 and 199.

For at least these reasons, claims 1, 58, 120, 197 and 199, and dependent claims 3-28, 58, 60-89, 121-122, 124-150, 198, 200 and 223-226 distinguish patentably over the cited references.

Furthermore, none of the cited references disclose a fluid interface port capable of forming a virtual wall. The virtual wall forms a *direct* interface between the microchannel interior and the microchannel exterior, allowing direct access to the liquid in microchannel without introducing dead or unswept volume in the microchannel. Even if the devices in the cited references were capable of forming menisci, the menisci would not form *virtual walls*.

As used in the present application, a "virtual wall" is not an interconnecting channel or simply an opening to a channel. Rather, a virtual wall refers to a particular type of *meniscus*

formed in an opening of a side wall of a microchannel that is sized and dimensioned so that the meniscus essentially replaces the removed portion of the side wall that defines the fluid interface port. A virtual wall does not refer to *any* and every type of meniscus (i.e., all menisci are not virtual walls), but rather a meniscus in an opening that is specifically sized and configured so that the fluid flow through the microchannel is not affected by the fact that a portion of the side wall of the microchannel is absent and that the microchannel is exposed to the environment (see the specification at page 17, lines 10-30). The term "virtual wall" is used to denote that the meniscus formed by a fluid in the fluid interface port essentially replaces the removed portion of the side wall that forms the port. The word 'virtual' in the present claims refers to the effect that the overall liquid flow through the separation channel of the electrophoretic system is not influenced by the virtual wall, i.e. the flow of liquid in the micro-plate having a virtual wall is substantially identical to the flow of liquid through an identical micro-plate in which no virtual wall is formed.

The virtual wall forms a *direct* interface between the microchannel interior and the microchannel exterior, allowing direct access to the liquid in microchannel without introducing dead or unswept volume in the microchannel. In contrast, channel 301 in the Chow reference does not *directly* interface a microchannel to the environment surrounding the device. In addition, the vent 70 in Handique also does not forma direct interface, but rather a long, indirect opening with a large dead volume.

The virtual wall of the claimed invention also serves to seal liquid inside of the microchannel through a range of pressures in the microchannel. There is no teaching or suggestion that liquid is sealed in the device by the channel 310 of Chow, the vent 70 of Handique or the port 24 of Fuchs.

A fluid interface port forming a virtual wall according to the present invention generally has a diameter of between about 0.1 μm and about 200 μm and preferably between about 25 μm and about 125 μm and most preferably between about 50 μm and about 100 μm, or another suitable cross-sectional dimension such that resulting capillary forces retain liquid within the microchannel. There is no teaching or suggestion that the channel 301 of Chow, the vent 70 of Handique and the port 24 of Fuchs have such dimensions.

As set forth in independent claims 58 and 90, a virtual wall also has a relatively low dead volume, i.e., less than about one nanoliter or one picoliter. As set forth in the specification, "dead volume" refers to the volume of liquid retained in a fluid interface port (i.e. the volume of liquid the fluid interface port holds that is not flushed through the fluid interface port by the flow field of the first liquid through the microchannel). The relatively small dead volume provided by the virtual wall results in a direct fluid interface allowing direct injection of a precise volume of sample into the interior of the microchannel from the exterior of the microchannel. The ability to directly inject sample into the microchannel due to the low dead volume of the fluid interface port provides improved control over the amount of sample that is injected into the microchannel, allows efficient use of sample, and significantly reduces waste of the sample. Furthermore, the direct injection provided by the very small dead volume reduces or prevents cross-contamination between different samples and allows a second substance to be directly injected into the system immediately after a first substance without requiring flushing of the fluid interface port. In contrast, the channel 301 of Chow, the vent 70 of Handique and the port 24 of Fuchs have large dead volumes.

The larger dead volumes in the cited references may lead to dispersion of the sample, a time delay between the time of injection and the time when the sample enters the microchannel, injection inefficiency, potential cross-contamination between different samples and difficulty controlling the amount of sample that actually reaches the microchannel. These problems are avoided or reduced by the use of the fluid interface port forming a virtual wall having a dead volume of less than about one picoliter according to the illustrative embodiment.

New claims

New claims 223-224 depend from independent claims 90 and 201, respectively, and further specify that the meniscus surface of the virtual wall is co-planar with a corresponding side wall, a feature also not taught or suggested in the cited references, as described above.

New independent claim 225 also recites that the meniscus of the virtual wall has a meniscus surface that is co-planar with a corresponding side wall, and therefore also distinguishes over the cited references.

In summary, because the cited reference do not disclose a fluid interface port including a cover layer that is immiscible or non-evaporating, as recognized by the Examiner, claims 90-99, 101-119 and 201 are now in immediate condition for allowance.

In addition, the cited references fail to disclose a fluid interface port defining a meniscus that is co-planar with a side wall in which the port is formed, placing claims 1, 3-28, 58, 60-89, 120-122, 124-150, 197-200 and 223-225 are in condition for allowance.

Claims 1, 3-28, 58, 60-97, 99-122, 124-150, 197-224 should also be allowed, because the cited references do not disclose a fluid interface port forming a virtual wall and having a diameter that is significantly larger than a depth of the fluid interface port so as to minimize a total volume.

CONCLUSION

In view of the above amendment, applicant believes the pending application is in condition for allowance.

Applicant believes no fee is due with this statement. However, if a fee is due, please charge our Deposit Account No. 12-0080, under Order No. TGZ-001A from which the undersigned is authorized to draw.

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Respectfully submitted,

By _____

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